D2

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
2 May 2002 (02.05.2002)

PCT

(10) International Publication Number
WO 02/35752 A2

(51) International Patent Classification[7]: H04L

(21) International Application Number: PCT/SE01/02360

(22) International Filing Date: 26 October 2001 (26.10.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

0003903-2	26 October 2000 (26.10.2000)	SE
60/243,503	26 October 2000 (26.10.2000)	US

(71) Applicant *(for all designated States except US)*: **CELLPOINT SYSTEMS AB** [SE/SE]; Kronborgsgränd 7, S-164 46 Kista (SE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **BERGQVIST, Per** [SE/SE]; Urban Hjärnes väg 14, S-168 58 Bromma (SE). **CORNISH, Simon** [AU/US]; 2438 Curtis St., Berkeley, CA 94702 (US).

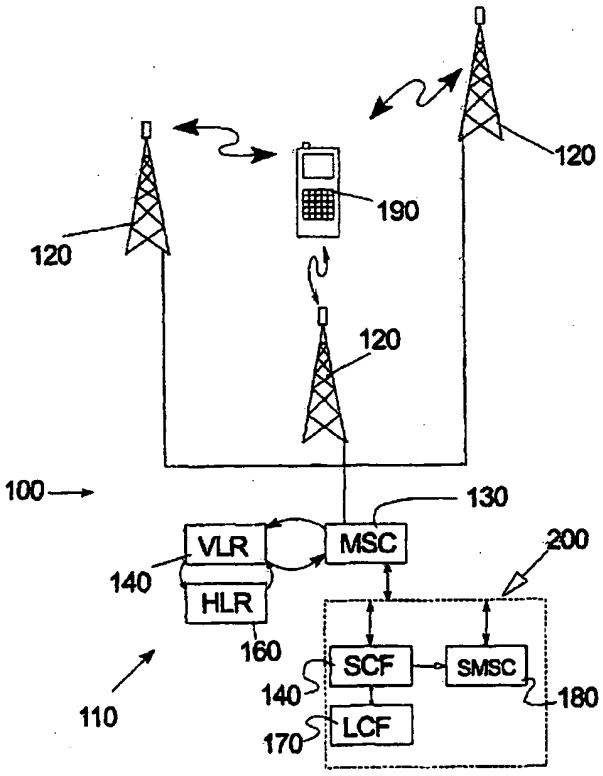
(74) Agent: **GÖTEBORGS PATENTBYRÅ DAHLS AB**; Sjöporten 4, S-417 64 Göteborg (SE).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EC, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European

[Continued on next page]

(54) Title: METHOD AND ARRANGEMENT RELATING TO RETRIEVING POSITION INFORMATION



(57) Abstract: A method of retrieving position information about a position of a Mobile Station (190) in a cellular network (100), the network comprising Mobile Switching Centre, MSC (130), Service Control Function (SCF) (140), Visitors Location Register (VLR) (150), Host Location Register (HLR) (160), Location Centre Function (LCF) (170) and Short Message Service Central (SMSC) (180), said MS having at least two operational modes: active and inactive. The method comprising the steps of directing by said SCF a request to said VLR through said HLR to obtain location information about said MS, said request comprising of a message of type of AnyTimeInterrogation (ATI) and/or ProvideSubscriberInfo (PSI) defined in a network communication protocol.

WO 02/35752 A2

patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

TITLE

METHOD AND ARRANGEMENT RELATING TO RETRIEVING POSITION INFORMATION

TECHNICAL FIELD OF THE INVENTION

The present invention relates to a method and system method of retrieving position information about a position of a Mobile Station in a cellular network, the network comprising Mobile Switching Centre Service Control Function, Visitors Location Register, Host Location Register and Location Services Arrangement, and said MS having at least two operational modes: active and inactive.

BACKGROUND OF THE INVENTION

In the GSM standardisation a collection of specifications, 03.71 etc, defines a standardized way for accessing location or position information corresponding to a mobile handset. Different methods for determining the location have been defined. The different methods require modifications to the existing networks, or new or modified terminals.

For the terminal centric methods, in which the mobile station determines its position, new or modified terminals are required. There is no support for the legacy of the mobile stations.

For the network centric methods, in which the communications network determines the position of the of the mobile station, a method returning service Cell ID and Timing Advance (TA) has been defined, which requires upgraded base station systems.

The major drawback with both of mentioned methods is the rollout time in network/terminals.

US 6,081,711, discloses a mechanism that guarantees the availability of necessary location data within a mobile communication network and also the transfer thereof to the appropriate

network node when needed a mobile station (MS) for use in the digital cellular communication network supporting unstructured supplementary service data comprises service means to perform the standard services between the mobile station (MS) and the digital cellular communication network, interface means to perform the machine interface functionalities at the mobile station (MS), and unstructured supplementary service data means to establish a transaction channel to the digital cellular communication network for the interface transfer of unstructured supplementary service data. In particular, location information indicating means are adapted to identify a cell identifier for a cell within the digital cellular communication network where the mobile station (MS) is roaming and also to output the cell identifier via the unstructured supplementary service data interface means. According to the invention it is possible to use the most exact location information to provide location specific services from the network side in a digital cellular communication network.

In US 6,052,597 the position of a mobile station in a cellular mobile telephone system, particularly a GSM system, is determined by carrying out a simulated call setup, i.e., the call setup is interrupted subsequent to a telephone-switching center (MSC) having received a paging response containing the identity of the cell and, optionally, a timing advance. The simulated call setup is initiated by generating a modified short message signal (SMS), which is not registered in the SMS catalogue of the mobile station and which is not shown to the user of the mobile station. The SMS commands the mobile station to carry out a position determining sequence in order to establish parameters for use in establishing the position of the mobile station, for example by commanding the mobile station to connect itself to a base station contained in its neighbor list, analyze the geographical position of the base station, and subsequently send the position determining parameters to a position handler. The geographical position of the base station is analyzed from the cell identity and, if available, the timing advance, the position of the mobile station being presented graphically on a picture screen and constantly updated after each call setup. The position handler generates the call setups. The SMS is modified such that the message includes a unique character sequence, e.g. (\$\$©©), and it includes additional data associated with the order or command.

According to GB 2344 024 A, a telecommunications system and method for providing location

information consist of either real-time data or historical data when the subscriber requested to be positioned is either absent or not reachable, to a requesting location application (LA). The historical data is preferably stored per subscriber in a database within a serving Mobile Switching Center/Visitor Location Register (MSC/VLR) following a successful positioning of that subscriber. This historical data can consist of the location information along with a time stamp indicating the time that the location information was obtained and stored in the MSC/VLR. The age of the location information can then be calculated by determining the difference between the current read value of the system clock and the value of the time stamp information stored in the MSC/VLR for that particular location information. The messages are sent through Gateway Mobile Network (GMLC)

SUMMARY OF THE INVENTION

The main object of the present invention is to provide an arrangement and a method, which overcomes the above-mentioned drawbacks, i.e., for the terminal centric methods, provide a support for the legacy of the mobile stations, and for the network centric methods eliminate requirement of upgrading base station systems.

Moreover, the problem to be solved is to be solved is to eliminate the rollout time in the network/terminals. None of the prior art documents deal with this issue.

Therefore the initially described method comprises the steps of directing by said LSA a request message to said VLR to obtain location information about said MS, said request comprising of a message defined in a network communication protocol. Preferably, said message is AnyTimeInterrogation (ATI) and/or ProvideSubscriberInfo (PSI), and said ATI is sent through said HLR.

In one preferred embodiment said LSA comprises of a Service Control Function, a Location Centre Function and Short Message Service Central.

Advantageously, the reply to said request from said VLR is controlled by said LSA, and if said reply contains information which does not meet certain criteria indicating that said MS is in an inactive mode, said MS is forced into an active mode by sending a short message, which updates information in said VLR. In this way also deactivated MSs are positioned. The criteria include location area information and/or location area information of certain age.

Preferably, said short message is one of SMS or USSD, without a need for modification of the short message.

In one embodiment, if the current VLR contains information about a last known serving cell of the MS, the last known serving cell is updated and subsequently the information through a LocationQuery is retrieved. The VLR does not store the last known serving cell information and returns only cell id information when a MS is in active mode. The cell id information is accessed by sending repeated LocationQuery requests during sending of the short message and the requests are based on a forced poll.

In one embodiment, the LSA, which originates said requests has detailed information about signaling and the delivery of the short message is realized using ForwardSM operation and it triggers paging in the MSC, and that the serving cell information is not be available in the MSC/VLR until it receives a paging response from the MS. Most preferably, a time period between the dispatch of ForwardSM and paging response from MS can be estimated and to reduce the number of ATI requests, the first request is delayed until the estimated time. The ATI request is repeated until a valid result has been returned or a delivery confirmation is received for the short message and when the short message has been delivered the MS returns to idle mode.

In one embodimenet, a ForwardSM operation is carried out, which includes a flag, MoreMessagesToSend (MMS), whereby the MSC maintains its radio resources towards the MS until a disabling message is delivered. If LSA has detailed knowledge about operations performed, it issues an ForwardSM with MMS enabled, followed by an ATI request and then a new ForwardSM with MMS disable is issued to release the radio resources.

In one embodiment, SCF can cooperate with a Location Centre Function (LCF) with the capability to transform the returned results into other geographical information.

Generally, the LSA is arranged to choose from different location providers. This allows use of different position providers

In one preferred embodiment, the LSA is provided with information about a mapping between a MS International ISDN Number (MSISDN) and an International Mobile Subscriber Identity (IMSI) and current VLR for the MS, whereby a PSI request is directed directly to said VLR. The collections is through issuing one of the SendRouting operations in GSM, including SendRoutingInfoForSM, and then derive a VLR number of the MSC number. The information is collected through any type of subscriber activity including USSD or SMS. It may also be collected using signaling link monitoring on some or the entire actual network nodes to track changes in current VLR. The cache is distributed among several nodes. In case of using cached information towards the VLR and if the mobile station is no longer present in the VLR, the cache entry is simply invalidated and the normal procedure to collect the mapping information between MSISDN and IMSI, VLR is performed and the (distributed) cache is updated.

The invention also relates to a system for retrieving position information about a position of a Mobile Station in a cellular network, the network comprising a Mobile Switching Centre (MSC), Service Control Function (SCF), Visitors Location Register (VLR), Host Location Register (HLR) and Location Services Arrangement (LSA). The MS has at least two operational modes: active and inactive. The LSA is arranged to direct a request message to said VLR to obtain location information about said MS, said request comprising of a message defined in a network communication protocol. The message is AnyTimeInterrogation (ATI) and/or ProvideSubscriberInfo (PSI).

BRIEF DESCRIPTION OF THE DRAWINGS

In the following, the invention will be further described in a non-limiting way under reference

to the accompanying drawings in which:

Fig. 1 is a schematic block diagram illustrating a communications network according to the invention, and

Fig. 2 illustrates the signalling structure in the communications network according to the invention.

DETAILED DESCRIPTION OF THE EMBODIMENT

In the standardisation of CAMEL (Customized Applications for Mobile network Enhanced Logic), the operation AnyTimeInterrogation (ATI) has been defined, which returns the location information, serving cell or location area, subscriber status and a timestamp. The location Information indicates the location of the served subscriber. The provision of location information is independent of the Mobile Stations (MS) status. As a part of the location information, an indication of the age of this information is delivered.

In the following, an alternate and novel method to achieve the same functionality is described. In general, the term LocationQuery will be used to indicate use of AnyTimeInterrogation or the alternate method.

A block diagram of a communications network 100, such as GSM, AMPS etc., incorporating a system 110 according to the invention is illustrated in fig. 1. The communications network 100 basically comprises a number of base station antennas 120 connected to a number of MSCs 130 (Mobile Switching Centres), which operate in a known way. The function of the GSM (or similar networks) is assumed to be well known to a skilled person and not described in detail herein.

The common features of the system according to the invention and the network comprise MSC 130, Service Control Function (SCF) 140, Visitors Location Register (VLR) 150, Host Location Register (HLR) 160, Location Centre Function (LCF) 170 and Short Message Service Central (SMSC) 180. However, LCF, SCF and SMSC can be arranged in one entity in the following

called Location Services Arrangement, LCA, 200.

With reference to the signalling diagram of fig. 2, if a service needs the Subscriber Status and/or Location Information for the served subscriber, the Service Control Function (SCF) 140 of a Location Service initiates a transaction with the Host Location Register (HLR) 160 through SRI SM (SendRoutingInfo ForSM), which returns a result for the invoke request. Then a ForwardSM message is directed to the VLR 140, which returns a Result to the Invoke message. Then SCF 140 requests information from HLR 160 by sending an ATI Request (ATIR). The HLR relays this request to the current VLR (Visitors Location Register) 140 in form of a ProvideSubscriberInfo (PSI) message. The result is returned via HLR to SCF. The information about the current serving cell for the mobile station will always be returned when the mobile station is in active mode. When the location information is needed, it is not always the case that the target Mobile Station is in active mode. Reasons could include requesting services via a disconnecting transport, such as SMS, or some other entity or when a user wants access the location information.

The SCF may inspect the returned location information and if it does not meet certain quality criteria, i.e., for example only location area is returned or the information is too old, the SCF can force the target mobile station to active mode, e.g. in cooperation with a Short Message Centre (SMSC) 180 to send a Short Message (SM) and thereby update the location information in VLR. This short message may use standard features defined in GSM to avoid the short message being displayed on the mobile station. To avoid this, a combination of suitable protocol identity and data coding scheme can be used (e.g. PID=64, DCS=240, etc.). The message could also intentionally be a normal short message notifying the user that the location of the MS is being accessed.

If the current VLR contains information about the last known serving cell, this procedure is enough to update the last known serving cell and subsequently retrieve the information through a LocationQuery.

A VLR implementation does not need to store the last known serving cell information and

returns only cell id information when a mobile station is in active mode. In this case there are two alternate methods to access the cell id information:

A first method is based on repeated LocationQuery requests during sending of the short message. The polling may either be an ordinary (forced) poll without any intelligence but it may also be refined, where the request originator, i.e. LCF, has more detailed knowledge about the signaling. The delivery of the short message is realized using the ForwardSM operation (or one of its successors, such as MO-ForwardSM, MT-ForwardSM, etc. defined in different MAP versions). This operation triggers a paging in the MSC. The serving cell information will not be available in the MSC/VLR until it receives a paging response from the mobile station. The time between the FW SM and PagerResponse from MSC can be estimated and to reduce the number of ATI requests, the first request may be delayed until the estimated time. The ATI request can be repeated until a valid result has been returned or a delivery confirmation is received for the short message.

When the short message has been delivered the mobile station returns to idle mode.

In an alternate method, a feature in the MAP Phase 2 protocol is utilized. In the MAP Ph 2 of Forward SM operation, there is a flag: MoreMessagesToSend (MMS), indicating if the service centers have more messages to send to the mobile station. If this indication is enabled, the MSC will maintain the radio resources towards the mobile station until a short message is delivered with the indication disabled. If the originating entity (LCF) has detailed knowledge about the operations performed, it may issue ForwardSM with MMS enabled, followed by an ATI request and then issue a new ForwardSM with MMS disable to release the radio resources.

SCF can cooperate with a Location Centre Function (LCF) with the capability to transform the returned results into other geographical meaningful information. The LCF can provide the necessary privacy enhancement features requested by the subscriber.

Preferably, the LCF can be arranged to choose from different location providers, including LCS defined ones.

As mentioned above and with reference to the lower part of fig. 2, in another embodiment, in order to perform a location request using ATI, the originating entity must always query the HLR. The HLR will then issue a PSI request towards the VLR to obtain the current location and status. The originating entity can issue a PSI request towards the VLR directly, if it knows the mapping between the Mobile Station International ISDN Number (MSISDN) and International Mobile Subscriber Identity (IMSI) and current VLR for the mobile station. This information, i.e. the mapping information between the Mobile Station International ISDN Number (MSISDN) and International Mobile Subscriber Identity (IMSI) and current VLR, can be collected using a number of methods and stored in a cache. One method would be to issue one of the SendRouting operations in GSM, including but not restricted to SendRoutingInfoForSM, and then derive the VLR number of the MSC number. An alternate method is to collect the information on any type of subscriber activity including USSD or SMS. When the mobile originated traffic reaches USSD GW or SMSC, the MSC or HCR may use (optionally) standard and/or property information elements to indicate IMSI, VLR or MSISDN.

Yet another method would be to collect the information using signaling link monitoring on some or the entire actual network nodes to track changes in current VLR.

The cache mechanism can easily be distributed among several node elements and the consuming entity does not have to be the same as the collecting entity. In the case of using cached information towards the VLR and if the mobile station is no longer present in the VLR, e.g., trough detach or purging, the cache entry is simply invalidated and the normal procedure to collect the mapping information between MSISDN and {IMSI, VLR} is performed and the (distributed) cache can be updated.

To provide the user an interface towards the actual service, USSD (Unstructured Supplementary Service Data) or SMS can be used. The service logic can then use the MSISDN received in the original USSD or SMS request to perform a LocationQuery. Preferably, this action is performed prior to acknowledging the original request and the mobile station will still be in active mode.

The location information may then be automatically transferred to the service application in addition to the service request information.

Although, we have described in the exemplary embodiments in which ATI or PSI are used, it is clear that the signalling to the VLR can involve any type of messages that return information about the subscriber mobile station's location and/or status.

The invention is not limited the shown embodiments but can be varied in a number of ways without departing from the scope of the appended claims and the arrangement and the method can be implemented in various ways depending on application, functional units, needs and requirements etc.

CLAIMS

1. A method of retrieving position information about a position of a Mobile Station (190) in a cellular network (100), the network comprising Mobile Switching Centre (MSC) (130), Service Control Function (SCF) (140), Visitors Location Register (VLR) (150), Host Location Register (HLR) (160) and Location Services Arrangement (LSA) (200), and said MS having at least two operational modes: active and inactive,
characterized by
directing by said LSA a request message (RM) to said VLR to obtain location information about said MS, said request comprising of a message defined in a network communication protocol.

2. The method of claim 1,
characterised in
that said message is AnyTimeInterrogation (ATI) and/or ProvideSubscriberInfo (PSI).

3. The method of claim 2,
characterised in
that said ATI is sent through said HLR.

4. The method of claim 1,
characterised in
that said LSA comprises of a Service Control Function (SCF) (140), a Location Centre Function (LCF) (170) and Short Message Service Central (SMSC) (180).

5. The method of claim 1,
characterised in
that a reply to said request from said VLR is controlled by said LSA, and if said reply contains information which does not meet certain criteria indicating that said MS is in an inactive mode, said MS is forced into an active mode by sending a short message, which updates information in said VLR.

6. The method of claim 5,
characterised in
that said short message is one of SMS or USSD.

7. The method of claim 6,
characterised in
that said criteria includes location area information and/or location area information of certain age.

8. The method of claim 7,
characterised in
that if the current VLR contains information about a last known serving cell of the MS, the last known serving cell is updated and subsequently the information through a LocationQuery is retrieved.

9. The method of claim 6,
characterised in
that the VLR does not store the last known serving cell information and returns only cell id information when a MS is in active mode.

10. The method of claim 7,
characterised in
that said cell id information is accessed by sending repeated LocationQuery requests during sending of the short message.

11. The method of claim 8,
characterised in
that said requests are based on a forced poll.

12. The method of claim 10,

characterised in

that LSA, which originates said requests has a detailed information about signaling and the delivery of the short message is realized using ForwardSM operation.

13. The method of claim 12,

characterised in

that it triggers paging in the MSC, and that the serving cell information is not be available in the MSC/VLR until it receives a paging response from the MS.

14. The method of claim 13,

characterised in

that a time period between the dispatch of ForwardSM and paging response from MS can be estimated and to reduce the number of ATI requests, the first request is delayed until the estimated time.

15. The method of claim 14,

characterised in

that said ATI request is repeated until a valid result has been returned or a delivery confirmation is received for the short message.

16. The method of claim 16,

characterised in

that when the short message has been delivered the MS returns to idle mode.

17. The method of claim 10,

characterised in

that a ForwardSM operation is carried out, which includes a flag, MoreMessagesToSend (MMS), whereby the MSC maintains its radio resources towards the MS until a disabling message is delivered.

18. The method of claim 17,

characterised in

that if LSA has detailed knowledge about operations performed, it issues an ForwardSM with MMS enabled, followed by an ATI request and then a new ForwardSM with MMS disable is issued to release the radio resources.

19. The method of claim 4,

characterised in

that SCF can cooperate with a Location Centre Function (LCF) with the capability to transform the returned results into other geographical information.

20. The method of claim 1,

characterised in

that the LSA is arranged to choose from different location providers.

21. The method of claim 6,

characterised in

that said LSA is provided with information about a mapping between a MS International ISDN Number (MSISDN) and an International Mobile Subscriber Identity (IMSI) and current VLR for the MS, whereby a PSI request is directed directly to said VLR.

22. The method of claim 21,

characterised in

that said collection is through issuing one of the SendRouting operations in GSM, including SendRoutingInfoForSM, and then derive a VLR number of the MSC number.

23. The method of claim 21,

characterised in

that the information is collected through any type of subscriber activity including USSD or SMS.

24. The method of claim 21,

characterised in
that the information is collected using signaling link monitoring on some or the entire actual network nodes to track changes in current VLR.

25. The method of claim 21,
characterised in
that the cache is distributed among several nodes.

26. The method of claim 24,
characterised in
that in case of using cached information towards the VLR and if the mobile station is no longer present in the VLR, the cache entry is simply invalidated and the normal procedure to collect the mapping information between MSISDN and IMSI, VLR is performed and the (distributed) cache is updated.

27. A system for retrieving position information about a position of a Mobile Station (190) in a cellular network (100), the network comprising a Mobile Switching Centre (MSC) (130), Service Control Function (SCF) (140), Visitors Location Register (VLR) (150), Host Location Register (HLR) (160) and Location Services Arrangement (LSA) (200), and said MS having at least two operational modes: active and inactive,
characterized in
that said LSA is arranged to direct a request message to said VLR to obtain location information about said MS, said request comprising of a message defined in a network communication protocol.

28. The system of claim27,
characterised in
that said message is AnyTimeInterrogation (ATI) and/or ProvideSubscriberInfo (PSI).

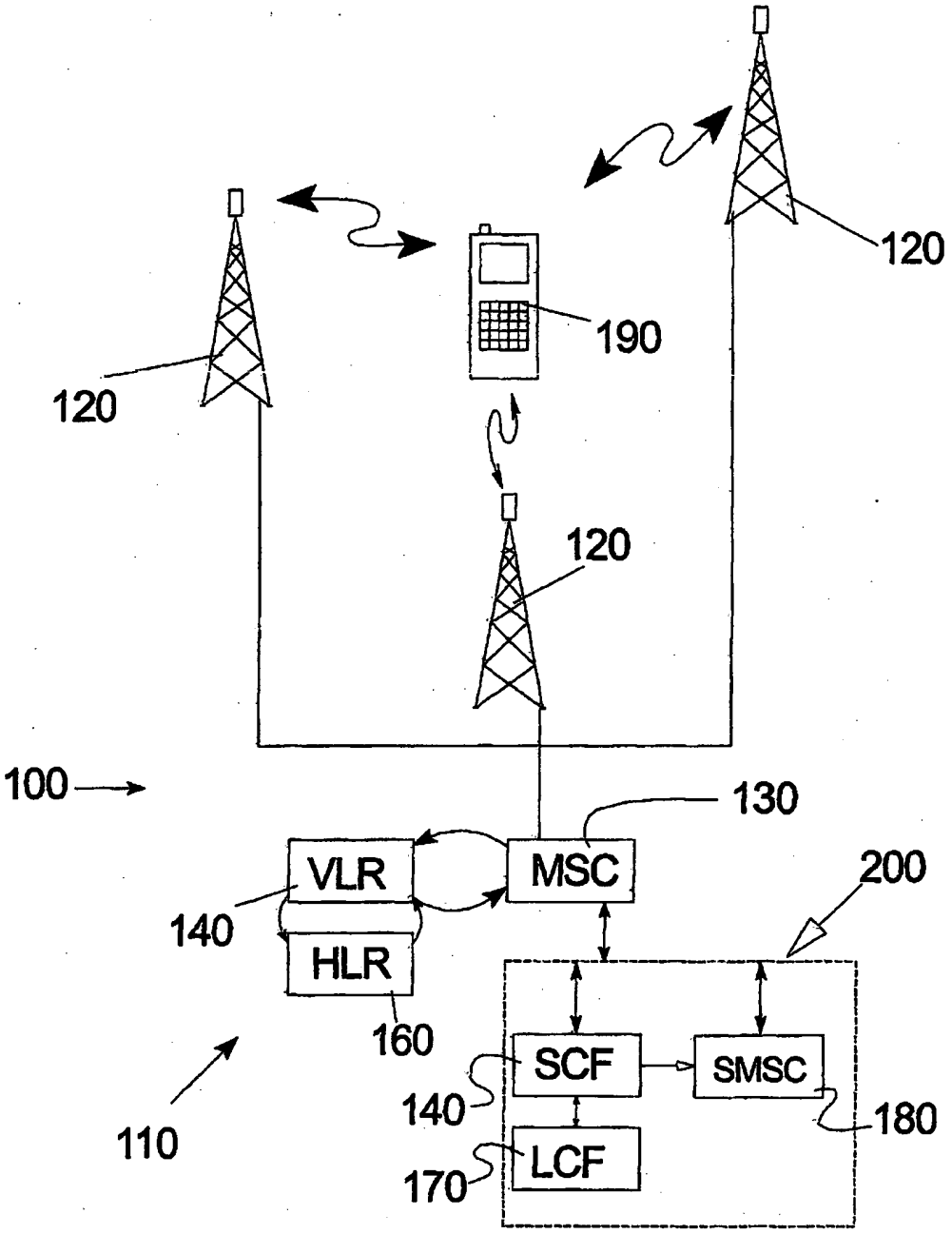
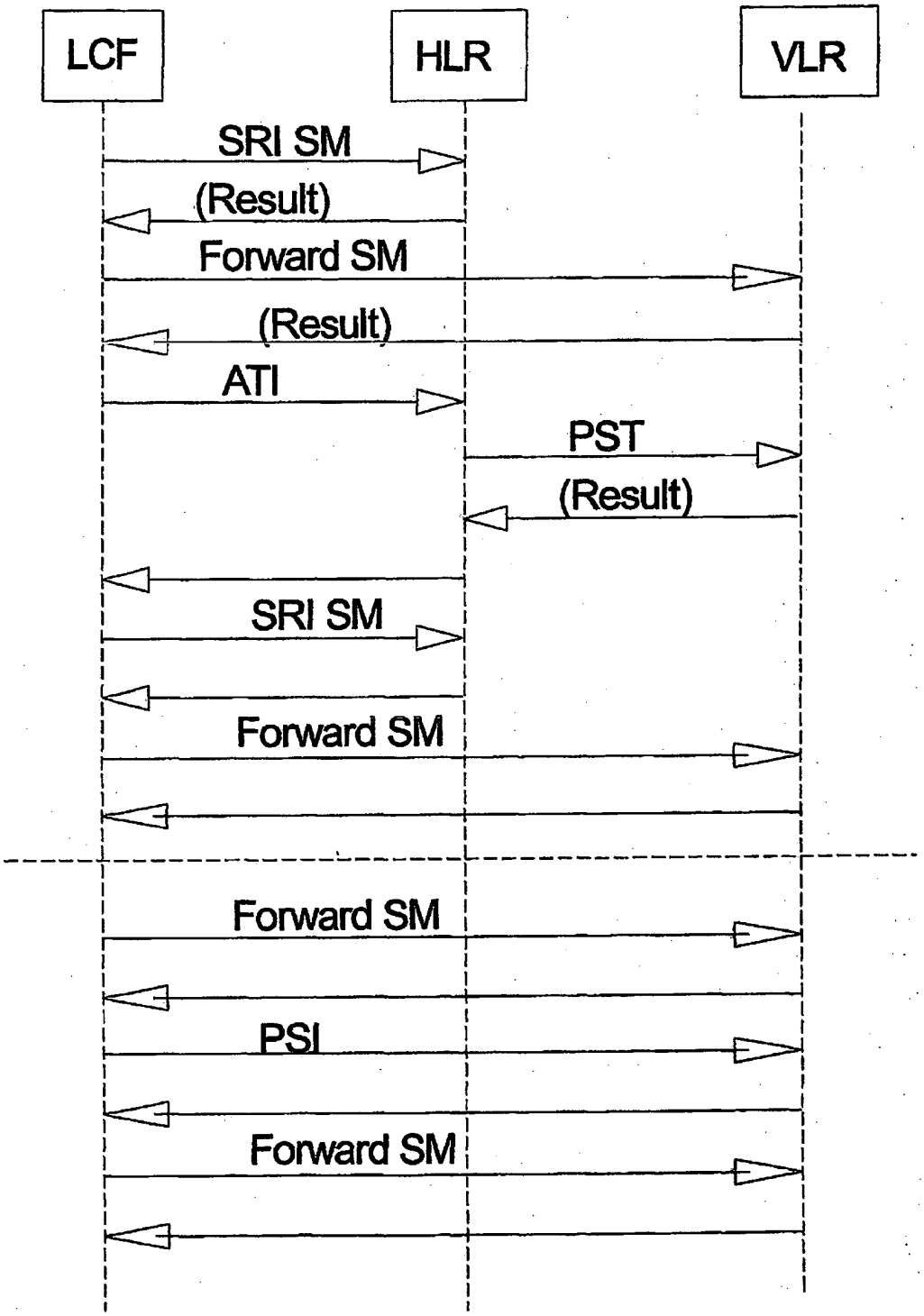

120
190
120
120
100
130
VLR
MSC
200
140
HLR
160
SCF
SMSC
140
180
110
LCF
170

Fig. 1


LCF
HLR
VLR
SRI SM
(Result)
Forward SM
(Result)
ATI
PST
(Result)
SRI SM
Forward SM
Forward SM
PSI
Forward SM